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North America is dependent upon irrigation.

The answer to the third question, "What specific legislation should be enacted to remedy the evils now confessedly existing?" will be found in the series of proposed bills appended to this report. They present the following recommendations:

1. That the Secretary of War, upon the request of the Secretary of the Interior, shall be authorized and directed to make the necessary details of troops to protect the forests, timber and undergrowth on the public reservations, and in the national parks not otherwise protected under existing laws, until a permanent forest bureau in the Department of the Interior has been authorized and thoroughly organized.

2. That the Secretary of the Interior shall be authorized and directed to issue the necessary rules and regulations for the protection, growth and improvement of the forests on the forest reserves of the United States; for the sale from them of timber, firewood and fencing to actual settlers on and adjacent to such reserves, and to the owners of mines legally located in them for use in such mines; for allowing actual settlers who have no timber on their own claims to take from the reserves firewood, posts, poles and fencing material necessary for their immediate personal use; for allowing the public to enter and cross the reserves; for granting to county commissioners rights of way for wagon roads in and across the reserves; for granting rights of way for irrigating ditches, flumes and pipes, and for reservoir sites; for permitting prospectors to enter the reserves in search of valuable minerals; for opening the reserves to the location of mining claims under the general mineral laws; and for allowing the owners of unperfected claims or patents, and the land-grant railroads with lands located in the reserves, to exchange them

under equitable conditions for unreserved lands.

3. That a bureau of public forests shall be established in the Department of the Interior, composed of officers specially selected with reference to their character and attainments, holding office during efficiency and good behavior and liberally paid and pensioned.

4. That a board of forest lands shall be appointed by the President to determine from actual topographical surveys to be made by the director of the Geological Survey what portions of the public domain should be reserved permanently as forest lands and what portions, being more valuable for agriculture or mining, should be open to sale and settlement.

5. That all public lands of the United States more valuable for the production of timber than for agriculture or mining shall be withdrawn from sale, settlement and other disposition and held for the growth and sale of timber.

6. That certain portions of the Rainier Forest Reserve in Washington and of the Grand Canyon Forest Reserve in Arizona shall be set aside and governed as national parks.

THE AMERICAN PHYSIOLOGICAL SOCIETY.

THE fourth special meeting of the American Physiological Society was held in Washington, D. C., on May 4, 5 and 6, 1897, in conjunction with the fourth Congress of American Physicians and Surgeons. The sessions were held at the Columbian University. The following communications were presented and discussed:

A new form of Gastric Cannula. W. T. PORTER.

Phlorhizin Diabetes in Dogs. G. LUSK.

The continued frequent administration of phlorhizin to dogs produces in them a form of diabetes in which, during starvation or meat nutrition, sugar is eliminated in the

urine in the average proportion of 3.75 g. to every one gram of nitrogen. If we neglect the small quantity of nitrogen in the fæces, this means that for every 6.25 g. of proteid destroyed in the body 3.75 g. of sugar may be obtained, or sixty per cent. of sugar from the proteid molecule. This sugar is completely fermentable with yeast; it is only very slightly affected by boiling with 10% hydrochloric acid, and it rotates polarized light as does dextrose. If dextrose be fed to dogs suffering from this form of diabetes, it is almost quantitatively eliminated in the urine. If levulose and galactose be fed, dextrose appears in increased quantity in the urine, but no levulose or galactose. The production of phlorhizin diabetes in starving dogs may cause an increased proteid metabolism of four hundred and fifty per cent.

Further Contributions to the Physiology of Deglutition. S. J. MELTZER.

Kronecker and Meltzer have advanced the view, on the basis of convincing experiments, that in the act of deglutition fluids and semi-solids are not carried down by peristalsis, but are rapidly squirted down the œsophagus by the rapid contraction especially of the mylohyoid muscles. After M. discovered the presence of the 'squirt-murmur' opposite the cardia about six seconds after the beginning of deglutition, the authors supplemented their view by the assumption that the fluid remains above the cardia until it is carried into the stomach by the peristaltic wave. In support of this latter view, which was contradicted by some writers, Meltzer reported some experimental observations. In rabbits and dogs the cardiac aperture of the stomach was directly observed while the deglutition was going on, and it was found that the entire swallowed mass was carried into the stomach by peristalsis only. Furthermore, by the removal of a few ribs and by the introduction of a 'speculum' into

various parts of the thorax the behavior of the entire thoracic œsophagus during deglutition could be satisfactorily scrutinized. Meltzer summarizes his observations as follows: During each act of deglutition liquid and air are rapidly squirted down into the œsophagus to a point about half way between the bifurcation of the trachea and the diaphragm and remain there until the peristaltic wave carries them down into the stomach.

Movements of the Alimentary Canal. H. P. BOWDITCH.

This paper was a brief preliminary report upon the results of some experiments performed in the laboratory of the Harvard Medical School by Messrs. A. Moser and W. B. Cannon, medical students, on the movements of the alimentary canal as studied by means of the X-rays and a fluorescent screen.

For this purpose moist bread, meat, mush or viscid fluids were mixed with subnitrate of bismuth. Food thus prepared is visible during the process of deglutition, and, if given in sufficient quantities, serves to outline the stomach and to render its peristaltic movements visible. Observations on a goose showed that a bolus of such food, swallowed without water, moved slowly and regularly down the œsophagus. There was no evidence of squirting. The movement was slower in the lower part of the neck. When water was given with the boluses the movement was irregular. Viscid fluids were swallowed in the same peristaltic way.

Experiments with a cat showed that a bolus of meat moved down the œsophagus regularly with no interruption or shooting movement. In the neck and from the level of the apex of the heart to the stomach the rate was lower than in the intermediate region. When water was added, the bolus shot down at irregular intervals, but at the level of the apex of the heart the rate

always slackened and the bolus moved slowly into the stomach. Thin mush and viscid fluids were also carried down by peristalsis. Large boluses stopped in the lower half of the thorax with each expiration, and descended with each inspiration. The examination of a cat's stomach filled with food mixed with subnitrate of bismuth showed the occurrence of a constriction at about the middle of the organ, which slowly moved towards the pylorus and was followed by other peristaltic waves at intervals of about ten seconds. The food thus pressed onward toward the pylorus did not pass into the duodenum, but returned apparently through the central portion of the organ, since the wave of constriction was never sufficient to obliterate the whole cavity.

The Reaction of some Animal Fluids. R. H. CHITTENDEN.

There is a general assumption on the part of physiologists that the alkaline reaction obtained with red litmus, in the case of many animal fluids, is due in great part to the presence of sodium carbonate. In many cases this assumption is quite erroneous. Thus, a large number of examinations of fresh bile from many species of animals shows that the fluid never contains any sodium carbonate; although alkaline to red litmus, the fluid is invariably acid toward phenolphthalein, 1 gram of bile requiring on an average 0.4 milligram NaOH to neutralize the free acid or acid salts present. With lacmoid, however, the reaction is invariably alkaline, thus showing the absence of free acids. The salts Na_2HPO_4 and NaH_2PO_4 undoubtedly play an important part in determining the behavior of the bile toward different indicators. As a rule, 5 c.c. of fresh ox bile require 0.5 c.c. of $\frac{1}{10}$ normal NaOH solution to render the fluid neutral to phenolphthalein and about 3.0 c.c. of $\frac{1}{10}$ normal HCl solution to make the fluid neutral to lacmoid.

Human mixed saliva is likewise acid to phenolphthalein; on an average 5 c.c. of filtered saliva require 0.6 c.c. of $\frac{1}{10}$ normal NaOH solution to render the fluid neutral to phenolphthalein. Toward most other indicators the fluid reacts alkaline, viz., with rosolic acid, litmus, lacmoid, congo red, alizarin, etc.

The submaxillary saliva of the dog, however, obtained on stimulation of the chorda tympani, is faintly alkaline to phenolphthalein, but 5 c.c. of the fluid generally require 1.3 c.c. of $\frac{1}{10}$ normal HCl solution to render the fluid neutral to litmus and lacmoid. Succus entericus and pancreatic juice undoubtedly owe their alkalinity in great part to the presence of sodium carbonate and bicarbonate.

The Proteolytic Action of Papain. R. H. CHITTENDEN.

The results of some quantitative experiments made by Mr. McDermott, designed to throw light upon the relative peptone-forming power of papain, were reported. The following experiment with coagulated egg-albumen, in the presence of 0.25 per cent. Na_2CO_3 and chloroform at 40°C ., may serve as an illustration of the character of the results.

	24 hours digestion.	48 hours digestion.
Undissolved residue (mostly antialbumid) }	35.8 per cent.	32.8 per cent.
Neutralization precipitate	1.7 "	0.9 "
Proteoses	26.7 "	24.3 "
Peptones	35.8 "	42.0 "

Especially noticeable is the behavior of deutero-albumose as formed by papain, when injected into the blood of a dog, in the proportion of 0.5 gram albumose per kilo of body weight. Unlike the corresponding albumose formed in gastric digestion, this substance does not appear to affect blood pressure, neither is there any noticeable effect upon the temperature of the body. Coagulation of the blood, however, is somewhat retarded, although not to the same extent as with ordinary deutero-

albumose. Diuresis, on the other hand, is very marked and in fifty minutes after the injection of the albumose fully 50 per cent of the substance is found in the urine which rapidly accumulates in the bladder. On removing the albumose from the urine by saturation of the fluid with ammonium sulphate a strong reaction for true peptone can be obtained, thus showing that in the elimination of the albumose from the body a certain amount of the substance is transformed into peptone, presumably in the epithelial cells of the kidney.

A Search for Pexin. J. W. WARREN.

The presence of pexin, the milk curdling ferment (otherwise 'labferment,' or 'rennin') in the digestive apparatus of non-mammalian vertebrates has been fully demonstrated. In the Bryn Mawr laboratory investigations have been made by various students which help to make more probable the opinion that there is no vertebrate in which the curdling ferment does not exist. A similar substance is known to occur in many plant juices and also in certain microorganisms. This wide distribution of such a peculiar material or materials raises interesting questions as to its significance and also concerning the value of the clotting of milk as incidental to the digestive process.

Does such a ferment exist among invertebrates? Some little time ago the stomachs of a few lobsters were examined in the Bryn Mawr laboratory. Chloroform extracts were prepared and were found to have no curdling action, nor were they made active by acidulation and subsequent neutralization in the usual manner. When neutralized with calcium carbonate (which is probably equivalent to the addition of soluble calcium compounds) the liquid acquired the power of clotting milk. Recently the question has been taken up again. Fresh earthworms were carefully washed, chopped into fine pieces and extracted by chloroform

water. This infusion was inert, but became active after treatment which is known to transform the zymogen. In another series the digestive tract was isolated, opened and thoroughly washed, and then put into chloroform water. This extract could not be made to coagulate milk by any of the methods which are ordinarily successful for the demonstration of pexin or its forerunner, pexinogen. This divergence may be due to the accidental exhaustion of the glands in the second series, or perhaps to the presence of bacteria in the contents of the digestive canal of the first lot of worms. Other less probable explanations might be given. The digestive apparatus of oysters and clams has also been examined in a preliminary way, but thus far only with quite negative result.

Note upon the Physiological Effects of Injections of Extracts of the Hypophysis Cerebri. W.

H. HOWELL. Read by title.

Extracts were made of the glandular or anterior lobe of the hypophysis cerebri and the posterior or infundibular lobe, and the effects were tested separately by injections into the circulation of dogs under the influence of various narcotics. Usually the extracts were made by rubbing up the portion used in a few drops of glycerine and diluting this mixture, after it had stood several hours, with a greater or less quantity of normal saline. It was found that extracts thus made of the glandular lobe have no distinct or constant effect on the circulatory organs, while the extracts of the infundibular lobe have a marked influence on the heart rate and blood pressure. When the vagi were intact this effect consisted usually in a rise of pressure, followed quickly by a temporary fall during which the heart rate remained unchanged or showed some acceleration, and this was followed by very slow and powerful heart beats lasting from a few minutes to half an hour or more, during which the pressure

rose gradually to a maximum above the normal pressure and then declined more slowly. In these experiments the maximum rise of pressure varied from 20 to 60 mms. Hg. and the maximum reduction in pulse rate varied from 40 to 60 per cent. of the rate existing before the injection. When the vagi were cut, or the animal was atropinized, the injections caused a rise of pressure, followed in some cases by a temporary fall, and then a more gradual but pronounced rise, together with a slower and more powerful heart beat. Under these conditions the maximal rise of pressure varied from 50 to 90 mm. Hg., while the maximal slowing of the pulse ranged from 17 to 35 per cent. of the rate before injection. Animals deeply under ether alone behaved in this respect like animals with the vagi cut. The slowing of the heart caused by extracts of the infundibular lobe seems, therefore, to be due in part to an effect upon the cardio-inhibitory center and in part to a peripheral effect, differing in this latter respect from suprarenal extracts. The effect upon the blood pressure seems to be due mainly to a peripheral effect, since it can be obtained readily in animals with the cord severed from the medulla and with part of the thoracic cord extirpated. As compared with extracts of the suprarenal bodies the effect of these extracts are characterized by their long duration, and the longer interval of time that must be allowed in order to obtain a similar effect from a second injection.

A Contribution to the Physiology of the Suprarenal Capsules. G. P. DREYER.

The most striking effects of the injection of extracts of the suprarenals into blood vessels are general vaso-constriction with rise of blood pressure, slowing of pulse with intact vagi, and acceleration of pulse with vagi cut or paralyzed by atropin. Is the active substance contained in such extracts a product of the normal activity of

the gland cells, *i. e.*, a true internal secretion, or the result of post-mortem changes? If the former a greater amount of it would be contained in blood coming direct from the gland than in blood taken from some other systemic vein, and this increase might be detected by the effects produced by intravenous injections of adrenal blood as compared with the effects of similar injections of blood from other veins. The author has made a series of such experiments on ten anesthetized dogs. Femoral blood and adrenal blood were alternately injected into the jugular vein in quantities ranging from 5 c.c. to 40 c.c., either into the same animal from which it had been taken or into a fresh animal. In every case the adrenal blood gave an appreciable rise of pressure, in some cases exceeding 40 per cent., while the inhibition of the heart before section of the vagi, or the acceleration after atropine injection, were practically constant phenomena. The variation in the extent of the effects must probably be ascribed to differences in the secretory activity of the gland in the different dogs. Furthermore, in general, the effect was greater the slower the outflow from the adrenal vein, and apparently greater when the injection was into a dog other than the one yielding the adrenal blood. Blood from the femoral vein gave negative results.

Gases of the Blood during Nitrous Oxide Anæsthesia. G. T. KEMP.

The author's previous experiments have shown that when enough air or oxygen is mixed with nitrous oxide to keep an animal alive, anæsthesia can be maintained for a considerable length of time without risk of life to the animal. When nitrous oxide is replaced by nitrogen, the anæsthesia passes off. This shows that nitrous oxide possesses specific anæsthetizing properties not possessed by nitrogen.

A more thorough knowledge of the condition of the system during nitrous oxide

anæsthesia has been obtained by drawing blood for analysis while the animal was connected with a kymograph and breathing N_2O + air or N_2O + pure oxygen. The analysis of the blood gases shows that even when the animal was so deeply anæsthetized as to endure stimulation of a sensory nerve without pain the blood contained enough oxygen to support life. The CO_2 in the blood was greatly diminished. The average amount of N_2O in the blood during anæsthesia was 28 vols. per cent. (gas at $0^\circ C.$ and 760 mm.). A study of the respiratory exchange indicates that the metabolism was lowered and that the system adapted itself to the small amount of oxygen present in the inspired air. The theory frequently found in text-books that nitrous oxide anæsthetizes solely by asphyxia is erroneous, and the safety of nitrous oxide compared with chloroform or ether merits that nitrous oxide, properly mixed with oxygen, be given a wider trial even in major surgery.

On the Production of Idioventricular Rhythm in the Mammalian Heart. A. R. CUSHNY.

The method employed was the stimulation of the ventricle in the dog by single induction shocks at a definite point in the relaxation. As a general rule the ventricular rhythm was accelerated, and both contraction and relaxation became imperfect. Not infrequently, however, the ventricular systole was stronger during stimulation than before and afterwards, and this was explained as being due to the dislocation of the auriculo-ventricular rhythm. In the great majority of cases the auricle assumed the accelerated ventricular rhythm, and the auricular systole became remarkably weak. This weakness is due in part to the acceleration of the rhythm, in part to the fact that the auricle contracts while the ventricle is in full contraction and has, therefore, to work against much greater resistance than normally.

The Cause of the Heart Beat. W. T. PORTER.

Any part of the dog's ventricle, even the apical fourth, will contract rhythmically, when cut away from the remainder of the ventricle and fed with warmed, defibrinated dog's blood through a cannula placed in the coronary artery ramifying in the extirpated part. Hence: (1) the cause of the rhythmic contraction of the ventricle lies within the ventricle itself; (2) the cause of the rhythmic contraction is not in a single localized coordination center; (3) the coordination mechanism, whatever it may be, is present in all parts of the ventricle; (4) the integrity of the whole ventricle is not essential to the coordinated contraction of a part of the ventricle; (5) assuming the correctness of the general belief in the absence of nerve cells from the apical half of the ventricle, the rhythmic coordinated contraction of the ventricle is not dependent on nerve cells.

A thin piece of the beating ventricle of the dog's heart *in situ* in the living animal may be partly severed from the apical portion in such a way that the isolated piece remains attached to the remainder of the ventricle only by its nutrient vessels, all muscular connections being cut. The heart and the isolated piece continue to contract. On slowing the heart by vagus excitation, the rhythmical contractions of the isolated piece may be watched without difficulty. Their rhythm then differs from that of the remainder of the heart. It follows that the rhythmic contractions of the isolated mammalian apex are not due to changes in the blood during its defibrination.

The Recovery of the Mammalian Heart from Fibrillary Contractions. W. T. PORTER.

Recovery of the dog's heart, or of any isolated part of it, from strong fibrillation produced either by electrical stimulation, mechanical insult, or sudden deprivation of blood supply, is secured by feeding the part with defibrinated dog's blood through its coronary artery.

On the Relation between the Beat of the Ventricle and the Flow of Blood through the Coronary Arteries. W. T. PORTER.

When an isolated piece of dog's or cat's ventricle is fed through the coronary artery, the flow from the veins is seen to be greater during systole than during diastole. In an extirpated heart, supplied with blood at a constant pressure through the coronary arteries, a pulse synchronous with the systole may be observed in the superficial auricular veins before and after their connection with the coronary sinus is severed. A similar but less marked pulse can be demonstrated in the coronary arteries. When a vein on the surface of a dog's ventricle *in situ* in the living animal is incised, and the heart slowed by vagus excitation, the flow from the cut vein is much increased during ventricular systole. These observations show that the contraction of the cardiac muscle compresses the veins, and to a less extent the arteries, in the substance of the heart. The systole must, therefore, facilitate the circulation through the heart muscle. The minimum manometer fails to show a negative pressure in the coronary arteries. The ventricle acts on the coronary circulation as a force pump, and not, to any noticeable extent, as a suction pump.

The Circulation through the Vessels of Thebesius.

W. T. PORTER (for F. H. PRATT).

In nearly all experiments the freshly excised heart of the cat has been used. The auricles are tied off from the ventricles, and both coronary arteries ligated. A large cannula is introduced into the right ventricle through the pulmonary artery and secured by a ligature. This cannula is now supported vertically, so that the heart shall hang from its lower end, and defibrinated blood poured in from the top, so as to fill the ventricle and rise in the cannula to a height of several inches. The ventricle distends, and all the coronary veins be-

come filled with blood; the coronary arteries remain empty. The ventricle begins to contract rhythmically, slowly at first, but gradually attaining the normal rate. Suspending the heart in warm normal saline solution facilitates the action. The blood within the ventricle and in the veins becomes venous, and, if contractions are to be sustained, must periodically be renewed. If a vein is opened, a small but steady outflow of blood occurs. Increasing the load beyond that furnished by a blood column of four or five inches lowers the force of contraction. Contractile activity may be kept up by this method for some time. Eight hours after excision is the maximum duration so far obtained, and in this case the ventricle was still active when left.

The experiments above described indicate plainly a nutritive phenomenon; the blood becomes reduced, and must be renewed in order to sustain contraction. That the contractions are not due to mere mechanical stimulus is proved by the fact that Ringer's solution fails to carry on the process. A genuine circulation exists between the ventricular cavity and the coronary veins through the vessels of Thebesius. The possibility of a nutrition from the ventricles direct may serve to explain some cases in which thrombosis or other stoppage of the coronary arteries has failed to destroy the normal activity of the heart. This method of nutrition bears a strong resemblance to that found in the frog.

The Innervation of the Heart of the Opossum (Didelphys virginiana). REID HUNT (with D. W. HARRINGTON). Read by title.

(1) *Vagus*. Standstill of the heart is easily produced by stimulation of the peripheral end of the vagus; the duration of the standstill is greater than that usually observed in other mammals. The heart beats slowly for some time after the cessation of the stimulus, *i. e.*, there is a long after-effect. By continuous weak stimula-

tion of the vagus the heart can be kept beating at a remarkably slow rate for some time and yet the blood pressure remain near or even rise above the normal.

(2) *Depressor*. In most cases there is a separate depressor nerve; it is usually formed by two roots, one from the superior laryngeal nerve, and the other from the ganglion of the trunk of the vagus. Stimulation of this nerve gives results entirely similar to those observed in the rabbit, *viz.*, fall of blood pressure and a reflex slowing of the heart.

(3) *Accelerator nerve*. The anatomical relations of these nerves resemble in general those found on the dog; stimulation of them causes marked increase in the heart rate and very frequently irregularity of the ventricles from their failure to follow all the auricular beats. Stimulation of the accelerators while the heart is being slowed by stimulation of the vagus causes an increase in the heart rate.

Some Experiments on the Lobster's Heart. REID HUNT. Read by title.

I. *Some General Properties of the Cardiac Muscle of the Lobster* (with Messrs. Bookman and Tierny). 1. The latent period caused by electrical stimulation is very short, varying according to the condition of the heart from $\frac{1}{25}$ to $\frac{1}{100}$ of a second. 2. The heart responds to stimulation during every phase of a contraction, whether this is spontaneous or has been caused by previous stimulation, *i. e.*, there is no refractory period (the latent period, however, was not investigated as to this point). 3. A true summation of contractions is easily produced; one contraction can be superimposed upon another until the resulting contraction is many times higher than any single (maximal) contraction. 4. Complete tetanus is readily produced, as has been observed by Howell for the crab's heart; the number of stimuli necessary to produce it varies greatly according to the

condition of the heart, 4 to 6 per second being sufficient as a rule. 5. The height of the contraction varies (up to a maximum) with the strength of the stimulus, *i. e.*, the 'all or nothing' law does not hold.

II. *The Effect of Changes of Temperature upon the Lobster's Heart* (with Messrs. Lyman and Williams). Most of the results were obtained with hearts removed from the body and placed in the lobster's defibrinated blood; the temperature of the blood could be altered as desired. The force and frequency of the beat increased as the temperature was lowered from that of the room (18° C.) to about 13° C., which seemed to be, as a rule, the optimum temperature for hearts in the body as well as for the isolated ones. As the temperature was lowered still farther, the beats became more rapid but feebler; the temperature was not carried below 2° C., but the heart beat well at this temperature. When the temperature was raised above the optimum, the beats became fewer and irregular and the heart went into heat standstill at a remarkably low temperature; upon cooling it beat again, unless it had been exposed to a too high temperature. The temperature at which a standstill occurred varied according to the condition of the heart; previous cooling and long exposure caused it to occur at very low temperatures. The heart was never observed to beat above 22° C., although it responded to electrical stimulation up to 27°. The crab's heart goes into standstill at a much higher temperature (45–50° C.). Sudden changes of temperature caused a temporary acceleration. A moderate degree of tension on the heart caused a much more rapid beat.

The Innervation of the Heart of the Guinea Pig.

D. W. HARRINGTON.

In the guinea pig the average blood pressure in the carotid artery is 78.25 mm. of mercury; the average rate of heart beat,

200 per minute; the average number of respirations at a temperature of 68° F., 72. Both vagus nerves are inhibitory and apparently equally so. They do not seem to be in a state of tonic activity. Stimulation of the central end of one vagus gives the usual slight fall of blood pressure, with slowing of the heart if the other nerve be intact. Stimulation of the peripheral end gives different results in different seasons of the year. In the fall and early winter months vagus excitation results in a gradual and moderate slowing but never stoppage of the heart, a gradual and moderate fall of blood pressure, and on cessation of stimulation a gradual return to the normal rate and blood pressure. In the late winter and spring months even with weak stimulation the heart is easily and suddenly stopped and held at a standstill; the fall of blood pressure is sudden and marked; the rise of pressure is generally sudden and often far above the normal, with a following gradual fall below the normal level. The tracings show considerable irregularity. A marked depression in the vitality of the animals was noticed at this time, which seems to be associated with the seasons and to be of practical importance, in view of the fact that guinea pigs are used so largely in experimental pathology. The heart 'escapes' quickly from vagus stimulation, but, on the whole, the latter seems to be deleterious to cardiac action, leaving the heart weaker and the blood pressure lower than normal. After escape from one vagus has commenced, stimulation of the other usually brings the heart to a standstill a second time. There is some evidence that in the guinea pig there is a separate depressor nerve, but further work is necessary to make it conclusive.

Ending of Sensory Nerves in the Viscera with special reference to such Endings in the Bladder. (Demonstration.) G. CARL HUBER. Gaskell, Langley and Edgeworth have

described large medullated fibres in the sympathetic system. These large fibres no doubt come from the spinal and other sensory ganglia. Kölliker suggests that some of these fibres are destined to supply the Pacinian corpuscles. The author has found that the bladder of the frog is a most suitable object for studying the free ending of such sensory fibres. Large medullated fibres, which could often be traced through several small sympathetic ganglia, found in the wall of the bladder, could then be followed through their several branchings until their terminal branches found between the epithelial cells lining the bladder were reached. A single nerve fibre was found to innervate an area of about $\frac{1}{4}$ sq. mm. These endings resemble very closely the free sensory endings described for the mouth and skin.

The preparations were stained in methylene blue and fixed in a solution of ammonium picrate. They were then cleared in a mixture of glycerine and ammonium picrate, in which solution they were mounted.

Endings of Sensory and Motor Nerves in the 'Muscle Spindles' of Voluntary Muscle with demonstration of preparations. G. C. HUBER (with MRS. DE WITT).

In 1860 Weismann described in embryonic striated muscle peculiar fibres with a large number of nuclei. Similar structures have been found widespread in vertebrate muscle and have been called 'muscle spindles.' Their nature has been variously regarded. They contain muscle fibres within a capsule and both motor and sensory nerves go to them.

The author has studied them in the frog, snake, cat, dog, rabbit, rat and guinea pig. The nerve fibres and endings were stained in methylene blue. They were then cleared in ammonium picrate and glycerine for teasing, or were cut into sections and double stained with alum carmine to bring out

the muscle fibres and capsule. In well-stained preparations the complexity of the nerve ending is too great for description here. It may, however, be stated that large medullated fibres (sensory), which supply these structures, divide often into several branches before reaching the spindle. Within the spindle they lose their medullary sheath and terminate in band-like structures which are wound around the muscle fibres of the spindles, usually making a few turns before ending on these fibres. Motor endings also occur on the spindle fibres, more often in the terminal portion of the spindle.

It may be suggested that, owing to the spiral arrangement of the terminations of the nerve fibres going to the spindle, the simple contraction of the muscle fibres of the spindle and their consequent enlargement might stimulate the nerve fibres.

The Protagon of the Brain. R. H. CHITTENDEN.

The author reported a series of results obtained by Mr. Frissell in a study of protagon. The total amount of phosphorus in sheep's brain by direct determination was found to be 1.664 per cent. calculated on the dry solid matter of the tissue. Of this amount 0.234 per cent. existed as protagon; 1.143 per cent. as lecithin or other like soluble bodies; and 0.213 per cent. in the form of nucleo-proteids, nuclein and inorganic salts. The results seemingly indicate that protagon contains but a small proportion of the total phosphorus of the brain and that other phosphorized organic bodies, such as the lecithins, are present, preformed in the tissue, in relatively large proportion. If we assume that all of the alcohol-soluble phosphorus of the brain, aside from the protagon, exists in the form of lecithins, we have 72 per cent. of the total phosphorus of the tissue present as lecithin, with only 15 per cent as protagon and 13-14 per cent. as nucleo-proteids and inorganic salts. Now

protagon contains approximately 1 per cent. of phosphorus, while distearyl lecithin contains 4.13 per cent. of phosphorus; hence on the basis of the above figures the dry solid matter of the brain contains as much or even more lecithin than protagon.

A large number of samples of pure protagon prepared from the brains of oxen, sheep and calves showed an average content of phosphorus of 1.12 per cent, thus agreeing closely with Rappel's results. Careful study of these samples showed that, contrary to previous statements, protagon tends to undergo cleavage by long-continued heating at 45°C. in 85 per cent. alcohol, a certain amount of an alcohol-soluble (at 0° C.) body richer in phosphorus than protagon, being split off while the residual protagon obtained by recrystallization at 0° C. contained a somewhat diminished percentage of phosphorus. In other words, the stability of protagon is not quite as great in 85 per cent. alcohol as is generally stated. On the other hand, the lability of protagon is not sufficiently great to account for all of the lecithins or other soluble phosphorized principles found in fresh brain tissue. Obviously these results do not furnish any evidence as to whether the lecithin or other phosphorized bodies found in the fresh brain tissue originate directly or indirectly from the metabolism or cleavage of protagon during the life of the tissue.

An Ergometer. J. McKEEN CATTELL.

The instrument exhibited was a dynamometer made to write on a kymograph. The maximum pressure of the thumb and forefinger or the movement of a single finger could thus be registered, and a series of movements showing fatigue could be recorded. The curves give the actual amount of work done, the height of the curves being proportional to the pressure in kilograms. The instrument was compared with Mosso's ergograph, and curves were shown in which the movements made in

lifting a weight and in extending a spring were simultaneously recorded. It was evident that the ergograph curves did not give a correct measure of fatigue, and of course gave no record when the weight was not lifted, whereas the ergometer curves measured more nearly the actual course of fatigue. The instrument is being used in the psychological laboratory of Columbia University to study fatigue and the effects of sensations and emotions on movements.

The Form of the Muscle Curve. F. S. LEE.

Under the author's direction the curve of contraction has been studied with improved apparatus in the muscles of the turtle, by Messrs. Furman and Turnure, and in the muscles of the frog, by Messrs. Beer and Gould. In the turtle the curves of different muscles differ greatly in form and time relations. The period of shortening is from two to five times that of the frog's gastrocnemius. A feature of interest is the enormous length of the period of lengthening which, *e. g.*, in the pectoralis major, may amount to fifteen seconds or three hundred times the period of the frog's gastrocnemius. With the present tendency to consider muscular relaxation an active rather than a passive phenomenon, this whole period of lengthening must be taken account of in determining the time relations of the muscular contraction. The turtle's muscles respond more readily to the make of an induction current than to the break, thus differing from those of the frog, and evidently possessing less irritability than the latter. This fact, as well as that of the very long curve of contraction, is in harmony with the sluggish movements of the animal.

In the frog the curves of different muscles thus far studied resemble one another in form and time relations much more closely. Some muscles seem to show a physiological resemblance to those of the turtle in having a prolonged period of relaxation.

The Nerve Impulse in its Relations to the Strength of the External Stimulus. C. W. GREENE.

The electric current which occurs in an isolated living nerve when a nerve impulse passes along its course may now be considered as a qualitative and quantitative measure of nerve physiology. The author has reinvestigated and extended Waller's results on this action current. Isolated nerves of frogs, turtles, cats and dogs, five to six centimeters long, were placed across stimulating and leading-off non-polarizable electrodes in a moist chamber. The faradic stimulating current was measured by an electro-dynamometer and the action current by a delicate Rowland galvanometer. (1) With equal increments of increase in stimulus above that necessary to produce a minimal deflection to a strength necessary to produce a maximal muscle effect there is a very rapid increase of action current and by equal increments. (2) With further increase in stimulus there is in the action current a continued strong increase, at first by equal but later by diminishing increments. If the results be plotted, the stimuli being placed along the abscissa and the successive action currents erected as ordinates, the curve here shows a concavity toward the abscissa. (3) With still stronger stimuli, to tenfold and more, there is only a slight further increase in action current and by equal proportional increments. This limb of the curve is important in its bearing on the nature of the nerve impulse.

Some Observations in a Case of Human Pancreatic Fistula. F. PFAFF.

The subject of the observation was a male patient in the City Hospital of Boston. Dr. H. W. Cushing had operated on the patient for an abdominal tumor. As a result of the operation a fistula formed, through which a clear watery fluid was secreted. This fluid had an alkaline reaction, digested proteids with formation of

peptone, transformed starch into sugar, and split neutral fat into fatty acid and glycerine, thus proving to be pancreatic fluid. The flow of this pancreatic secretion was observed during 48 consecutive hours. The quantities collected each hour were measured and the amount of solids and ash determined in each sample. The quantities secreted each hour were represented in a curve. This curve showed a striking resemblance to the curve representing the flow of bile, observed in a case of biliary fistula, which was reported by Dr. Pfaff at the last Christmas meeting of the Society. The total quantity of pancreatic fluid collected during 24 hours was much larger than is generally admitted for human beings. Some observations were also made on the composition of the urine and the feces during the time that the fistula was patent.

α -Methyl-quinoline as a Constituent of the Secretion of the Anal Glands of Mephitis Mephitica.

T. B. ALDRICH (with WALTER JONES).

In a paper published recently by the author it was stated that the secretion of the skunk, *Mephitis mephitica*, can be sharply separated by distillation into two approximately equal portions, and the more volatile portion was shown to be a mixture of mercaptans. From the portion of higher boiling point the authors have since succeeded in isolating a compound which can easily be identified as α -methyl-quinoline. The method of isolation is as follows: The higher boiling fraction of the original secretion is shaken several times with a 50 per cent. solution of caustic potash and then washed with water until all the alkali is removed. The product thus freed from all traces of mercaptans is extracted with several portions of very dilute hydrochloric acid, and the united acid extracts are evaporated to dryness on a water bath. The residue is taken up in a little water that has been acidified with hydrochloric acid,

and is treated with a solution of zinc chloride, when a finely crystalline precipitate of the zinc chloride addition product with the base is formed, which can be purified by crystallization from water. This compound is decomposed with an excess of sodium hydroxide, and the base thus liberated is distilled with steam. The distillate is extracted with ether and the ether is allowed to evaporate. There remains a practically colorless, highly refracting oil whose physical properties accord with those of α -methyl-quinoline. Two portions of the oil were dissolved in hydrochloric acid and treated, one with platinum chloride and the other with gold chloride. In each instance a beautifully crystalline precipitate was obtained, which on complete analysis gave results which show the base to be correctly represented by the formula $C_{10}H_9N$. The composition of the double compounds are in accordance with the formulas $(C_{10}H_9N \cdot HCl)_2$, $PtCl_4$ and $C_{10}H_9N \cdot HCl \cdot AuCl_3$.

A compound having the properties and composition of this base could only be one of the methyl-quinolines and, as only one of these isomeric substances forms an anhydrous double compound with platinum chloride, the identity of the natural base seems to be determined. This conclusion was confirmed by comparison of the base with artificially prepared α -methyl-quinoline.

Upon the afternoon of Wednesday, May 5th, in the National Theatre, the Society joined with the Association of American Physicians and the American Pediatric Society in a public discussion before the Medical Congress. The subject of the discussion was 'Internal secretions considered in their physiological, pathological and chemical aspects.' The Society was represented by two speakers: a paper by Professor W. H. Howell upon 'The General Physiology of Internal Secretions' was read by the Secretary in the absence of Professor

Howell because of illness; and Professor R. H. Chittenden read a paper upon 'Internal Secretions: Considered from a Chemico-physiological Standpoint.'

These addresses will appear in an early number of SCIENCE.

FREDERIC S. LEE,
Secretary.

COLUMBIA UNIVERSITY.

THE INTRODUCTION OF NEW TERMS IN GEOLOGY.

THE third circular sent out this year by the Committee of the International Congress of Geologists makes this statement: "*L' inondation de nouveaux termes dans la science a atteint de telles dimensions, que bientôt aucune mémoire d'homme ne sera en état de retenir toute la masse des dénominations nouvelles et que la lecture de chaque mémoire nécessitera l'emploi d'un glossaire special.*" In another paragraph new terms are spoken of as 'evidently nothing more than a useless incumbrance to the science.'

Writers on scientific subjects have often heard complaints about their 'hard words,' but these complaints have generally come from laymen; we have not before had an uprising in our own ranks. In our opinion it has come none too soon. One can scarcely read a paper on geology nowadays without feeling thankful for what is not in it, if he reaches the end without running upon some new term or some new use of an old one. Indeed, we lately saw a review of a text-book which the writer ended with the remark that not the least of the book's many virtues was the fact that the author had avoided the introduction of new terms.

We Americans have contributed our big share to this 'inundation,' and have aggravated the case by the use of Indian words and place-names that are not familiar even in this country except locally. In order to get an idea as to how far some of these words are comprehended by the

common run of educated people in this country, we have inquired of many persons what idea the word 'Monadnock' conveyed to their minds. Most of them had seen the word, but knew nothing of its original meaning. One young man said he didn't know what it meant, but it was the name of a big office building in Chicago. Another one knew it only as a warship in the American Navy.

Such names are said to be used on account of their fastening in the mind certain series of facts. But where is this thing to end? We now have a bare hill protruding from the ice called a 'Nunatak,' and if one of our term-makers should visit Iceland we should soon have 'Jökul,' the name for a snow-capped peak.

A hill with one history is a 'Monadnock,' with another it is a 'Cotoctin,' and with another it is a 'Katahdin.' For as good reason we might call a synclinal valley a 'Lackawanna,' a synclinal mountain a 'Shickshinny,' a monoclinical ridge a 'Pindamonhangaba,' and an anticlinal ridge a 'Jacarepaguá.' And when the bewildered European geologist doesn't know what they all mean we act the part of one of Bret Harte's characters who inquired of the man who hadn't heard of his partner:

What? "Didn't know Flynn,
Flynn of Virginia?
Look 'ee here, stranger,
Whar hev you been?"

New terms are often defended on the ground of their being logical. A little thought will convince any one that geology—not an exact science—can never have a logical and precise system of terms. Besides, the logic of the names of rocks, minerals and relief features has nothing to do with the science of geology as a science, while the fixity of a nomenclature is of much more importance than any logic or special fitness of the words themselves.

Names are mere conveniences—museum